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CADDIS FLIES (TRICHOPTERA) FROM FETLAR, SHETLAND

K.A. KENNEDY
Department of Biological Science, The Manchester Metropolitan University
Manchester M1 5GD
(Current address: 18 Barrington Drive, Glasgow G4 9DT)

INTRODUCTION

There have been no recent surveys of caddis flies in Shetland. The last two surveys were carried out more than twenty years ago (Jones and Mortimer, 1974; Crichton, 1971; Crichton *et al*, 1978) and none include the Island of Fetlar, the most easterly of the Shetland Isles. The present survey was conducted as part of a study of the breeding requirements of the Red-necked Phalarope, caddis flies being a known food item of this species (Cramp, 1983).

The objectives of the study were to monitor the changes in the numbers of caddis flies with time, and assess which variables in the structure of mire pools explain the variation in the number of caddis flies.

METHODS

The caddis flies were collected from emergence traps with a basal area of 0.5m x 0.5m and height of 0.25m, situated at the edge of 5 pools in each of the 4 mires surveyed. These emergence traps, based on the design of Owen (1989), were white pyramidal netting tents with guys connected to each corner of the tent. The guys were threaded onto bamboo canes set at each corner. The collecting head, situated at the top edge of the tent, was made from a short length of clear perspex tubing, heated and bent at the centre to an angle of about 60° with a lip below. This was superglued to a cap of a universal tube. A second cap was glued and taped back to back with the first, and a hole was burnt through the middle of the caps. A universal tube, half full of 70% ethanol, was then screwed onto the cap (O'Brien, in prep.).

The samples were collected weekly from June (week 22) to early August (week 31) 1993 and from June (week 23) to early July (week 28) 1994, sorted from the rest of the invertebrates caught and stored in 70% ethanol. The caddis flies collected in 1993 were sent to Liverpool Museum and identified by Dr Ian Wallace, and 1994 caddies flies were identified at the University of Paisley with the aid of Macan (1973).

Measurements of the structure of the mire pools within the emergence traps were collected by Mr Mark O'Brien (personal communication). These were water depth, sediment depth, vegetation height, % open water and the primary and secondary plant species, i.e. the species of plants most in abundance within the emergence traps.

RESULTS

A total of 237 caddis flies of the following 8 species were caught (numbers of each in brackets): *Plectrocnemia conspersa* (Curtis) (44), *Mystacides azurea* (Linnaeus) (50), *Agrypnia varia* (Fabricus) (6), *Limnephilus incisus* (Curtis) (85), *Limnephilus affinis* (Curtis) (44), *Limnephilus lunatus* (Curtis) (1), *Limnephilus auricule* (Curtis) (3) and *Oxyethira falcata* (Morton) (4).

Fig. 1. Weekly numbers of (a) all caddis flies, (b) *P. conspersa*, (c) *M. azurea*, and (d) *L. incisus*. Filled columns, 1993; open columns, 1994.

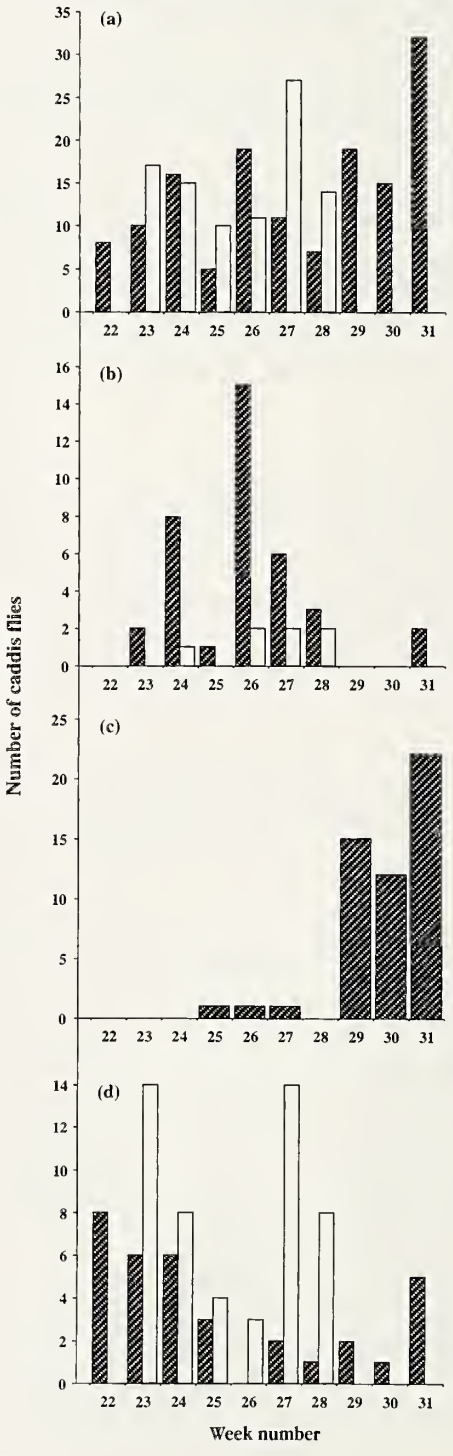

Fig. 2 Weekly numbers of *L. affinis*

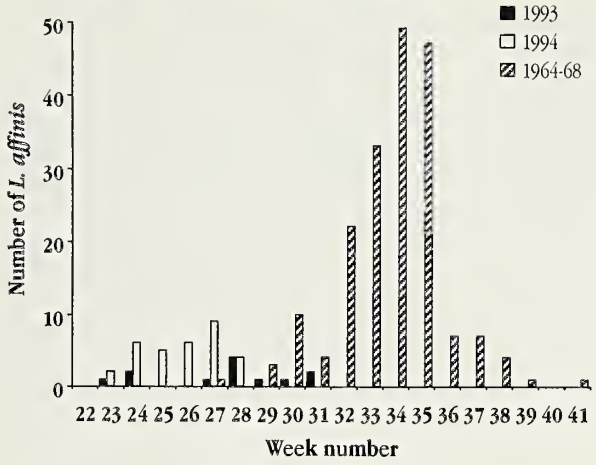

Table 1. Correlation of variables (structures of the mire pools which include abundance of the plant species) with the total number of caddis flies (all species).

Variable	Correlations of variables with numbers of caddis flies (+ Probability (P))
Carex rostrata	-0.586 (<0.01)
Carex nigra	0.302 (>0.05)
Potamogeton polgonifolius	-0.132 (>0.10)
Potentilla palustris	0.068 (>0.10)
Juncus bulbosus	0.385 (<0.05)
Menyanthes trifoliata	0.111 (>0.10)
Eleocharis palaestris	0.256 (>0.10)
Equisetum palustre	0.111 (>0.10)
Juncus articulatus	0.065 (>0.10)
Water depth (m)*	-0.243 (>0.10)
Sediment depth (m)	0.413 (<0.05)
Vegetation height (m)	-0.305 (>0.05)
% open water*	-0.214 (>0.10)

NB - total number of caddis flies and * variables were logged to normalise the data for analysis.

The maximum number of caddis flies (Fig. 1a.) caught in 1993 was 31 in week 31 and in 1994, 27, in week 27. Except for week 24, fewer caddis flies were caught throughout 1993 than in 1994. *P. conspersa* (Fib. 1b.) was caught in smaller numbers in 1994 than in 1993, with the maximum number caught being in week 26, 1993. *M. azurea* (Fig. 1c.) was only caught in 1993 with the maximum number caught in week 31. The maximum number of *L. incisus* (Fig. 1d.) caught in 1993 was 8, in week 22, and in 1994 was 14, in weeks 23 and 27. This species was found in smaller numbers throughout 1993 than in 1994. *L. affinis* (Fig. 2.) was caught earlier in this survey of caddis flies than in the 1964-1968 survey of Scotland (Crichton, 1971). In this survey *L. affinis* was found in lower numbers in each week of the study period of 1993 than in 1994. The maximum number caught was 9 in week 27, 1993.

Table 1. shows that when all the variables from the structure of the mire pools were correlated with the number of caddis flies the only variables to correlate significantly (i.e. P<0.05) were the abundance of *Carex rostrata, Juncus bulbosus* and sediment depth.

Table 2. Stepwise Multiple Regression analysis of variables with number of caddis flies.

Variable	t-ratio	Probability (P)
Carex rostrata	-3.86	0.001
Sediment depth	3.71	0.002
Water depth	-2.62	0.018
Overall-fit	10.75*	0.000
* = F statistic	(R^2=0.606)	

Table 3. Correlation of variables (structures of the mire pools which include abundance of the plant species) with the number of *L. incisus*

Variable	Correlation of variables with nos. of *L. incisus* (+ Probability (P))
Carex rostrata	-0.097 >0.10
Carex nigra	0.301 >0.05
Potamogeton polgonifolius	-0.006 >0.10
Potentilla palustris	0.449 <0.025
Juncus bulbosus	-0.050 >0.10
Menyanthes trifoliata	0.171 >0.10
Eleocharis palaestris	0.012 >0.10
Equisetum palustre	-0.185 >0.10
Juncus articulatus	-0.185 >0.10
Water depth (m)*	-0.496 <0.025
Sediment depth	0.150 >0.10
Vegetation height (m)	0.071 >0.10
% open water*	-0.406 <0.05

NB - *L. incisus* and * variables were logged to normalise the data for analysis.

Table 4. Stepwise Multiple Regression analysis of variables with numbers of *L. incisus*

Variable	t-ratio	Probability (P)
Water depth	-4.17	0.001
Potentilla palustris	3.36	0.004
Sediment depth	2.46	0.026
Overall fit	9.06*	0.001
* = F statistic	(R^2=0.56)	

Stepwise Multiple Regression analysis was used to assess which group of variables explained the most variation in the number of caddis flies. The group of variables produced by this analysis was *Carex rostrata,* sediment depth and water depth with 60.6% of the variation explained (adjusted R^2 = 0.606 - see Table 2.). The analysis suggests that when *C. rostrata* was an abundant plant species and water depth increases the number of caddis flies decreases and as sediment depth increases, so too does the number of caddis flies.

Table 3, shows that when all the variables from the structure of mire pools were correlated with the numbers of *L. incisus* the only variables to correlate significantly (i.e. P < 0.05) were the abundance of *Potentilla palustris,* water depth and sediment depth.

Stepwise Multiple Regression analysis was used to assess which group of variables explained the most variation in the numbers of *L. incisus*. The group of variables given by this

analysis was water depth, *Potentilla palustris* and sediment depth with 56% of the variation explained (adjusted R^2 = 0.56 - see Table 3.). The analysis suggests that as water depth increases the number of caddis flies decreases, and when *P. palustris* was an abundant plant species and sediment depth increases so too does the number of caddis flies.

DISCUSSION

In the previous surveys carried out in the Shetland Isles (Briggs, 1884; Carpenter, 1950; Evans, 1915, 1916; Grimshaw, 1906; Jones & Mortimer, 1974; King, 1890, 1896; McLachlan, 1884 a & b; Crichton, 1971) *Oxyethira falcata* was not recorded. Four *O. falcata* were found in this survey, all in one pool in 1993. This species was not found in 1994.

In this survey the most common caddis fly was *Limnephilus incisus*. By contrast the Rothamsted Insect Survey (Crichton, 1971) failed to catch *L. incisus* in Sandwich, Shetland, or any part of Scotland. The reason for this could be that, in the Rothamsted Insect Survey, light traps were used, thus limiting the capture to night flying caddis flies, whereas the emergence traps set up in the mire pools of Fetlar would capture caddis flies emerging from the pools at any time of the day.

In the first week of 1993 and 1994 in this survey the most numerous species was *L. incisus*, suggesting that this is the earliest of the caddis flies to emerge. Surveys starting earlier in the year would obviously be required to prove this.

In the Rothamsted Insect Survey (Crichton, 1971), *L. affinis* was not collected in Scotland until early July, whereas in this survey they were collected from early June. Flight periods of species which have larvae feeding as shredders, i.e. most of the limnephilids, are longer in southern Norway than in southern England (Otto, 1981). Therefore, since southern Norway and Fetlar, Shetland, are at a similar latitude there is a possibility that *L. affinis* could be collected for longer periods in Fetlar than further south in the British Isles. In Iceland, this species has a shorter flight period in the central Highlands than in the Lowlands (Gislason, 1978; Gislason *et al.*, 1990). Therefore, altitude may be an important factor in the flight period of this species.

The maximum number of *P. conspersa* were caught in the Faroes in late July (Anderson *et al.*, 1992) and in Scotland (Crichton, 1971) in late July to early August. In this survey the maximum number of *P. conspersa* were caught in the last week of June 1993 with none in late July and only 2 caught in the first week of August 1993.

In the 1994 survey in Fetlar the number of species was lower than in 1993 with neither *Mystacides azurea, Limnephilus lunatus* nor *Oxyethira falcata* recorded with fewer *Plectrocnemia conspersa*. By comparison, *Limnephilus incisus* and *Limnephilus affinis* were more numerous in 1994.

The group of variables which explains best the variation in the number of caddis flies is the abundance of *Carex rostrata*, sediment depth and water depth. The highest number of caddis flies - 48 (consisting mainly of *P. conspersa*) - were found in the pool with the deepest sediments (1.6m). This would be expected since a significant prey item of *P. conspersa* is chironomid larvae (Townsend & Hildrew, 1978), many species of which burrow in sediment (Fitter & Manuer, 1986). A negative correlation between the abundance of *C. rostrata* and caddis flies would not be expected if caddis flies were important in the diet of the Red-necked Phalarope. Batten *et al.* (1990) noted that during the breeding season of the Red-necked Phalarope they prefer to feed amongst emergent vegetation, especially tall and sparse *C. rostrata*.

The group of variables which explains best the variation in the number of *L. incisus* is water depth, abundance of *Potentilla palustris* and sediment depth. Water depth is an important variable since Hicken (1967) noted that *L. incisus* is found in rushy ditches in which there is not much water. Also, Wallace *et al.* (1990) noted that they are found in tussocky margins of pools, lakes and slow-flowing ditches which contract or dry out in summer. Therefore, *L. incisus* seems to require shallow water habitat. *Potentilla palustris,* another variable in the group, is commonly found in shallow water (Arlott *et al.*, 1981). Since both this plant and *L. incisus* inhabit shallow water, a positive correlation between them would be expected.

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REFERENCES

Anderson, T., Jorgensen, L.L. and Kjaerandsen, J. (1992). Relative abundance and flight periods of some caddis flies (Trichoptera) from the Faroes. *Entomologiske Meddelelser* 60, 117-123.

Arlott, N., Fitter, R. and Fitter, A. (1981). *The Complete Guide to British Wildlife*. Collins, London and Glasgow.

Batten, L.A., Bibby, C.J., Clement, P., Elliot, G.B. and Potter, R.F. (1990). *Red Data Birds in Britain: Action for Rare, Threatened and Important Species*. Published for The Nature Conservancy Council and The Royal Society For The Protection of Birds, L.T. and A.D. Poyster, London.

Briggs, C.A. (1884). A week's collecting on Uist. *The Entomologist* 17, 197-201.

Carpenter, G.D.H. (1950). Some insects (excluding Lepidoptera) from the Shetland Isles. *The Entomologist's Monthly Magazine* 86, 268-269.

Cramp, S. (1983). *Birds of the Western Palearctic*. Cambridge University Press; Cambridge.

Crichton, M.I. (1971). A study of caddis flies (Trichoptera) of the family Limnephilidea, based on the Rothamsted Insect Survey, 1964-1968. *Journal of Zoology* 163, 533-563.

Crichton, M.I., Fisher, D. and Woiwod, I.P. (1978). Life histories and distribution of British Trichoptera, excluding Limnephilidea and Hydroptilidea, based on the Rothamsted Insect Survey. *Holarctic Ecology* 1, 31-45.

Evans, W. (1915). Lepidoptera and other insects at Scottish lighthouses in 1915. *The Scottish Naturalist* 37, 130-135.

Evans, W. (1916). Trichoptera (caddis flies) from Fair Isle, Shetland. *Annals of Scottish Natural History* 1916, 72.

Fitter, R. and Manuer, R. (1986). *Collins Field Guide to Freshwater Life*. Collins, London.

Gislason, G.M. (1978). Flight periods and ovarian maturation in Trichoptera in Iceland. In *Proceedings of the 3rd International Symposium on Trichoptera* (Moretti, G.P. ed.) Junk, The Hague, pp.135-146.

Gislason, G.M., Halbach, U. and Fletchner, G. (1990). Habitat and life histories of Trichoptera in Thjorsarver, Central Highlands of Iceland. *Fauna norvegica Serie* B 37, 83-90.

Grimshaw, P. (1906). Insects from Fair Isle. *Annals of Scottish Natural History* 57, 118.

Hicken, N.E. (1967). *Caddis Larvae. Larvae of the British Trichoptera*. Hutchinson, London.

Jones, N.V. and Mortimer, M.E.A. (1974). Stream invertebrates on Foula. *The Glasgow Naturalist* 19, 91-100.

King, J.J.F.X. (1890). Neuroptera from the island of Unst. *The Entomologist's Monthly Magazine* 26, 176-180.

King, J.J.F.X. (1896). Notes on Trichoptera (including *Agrypnia picta*, Kol.), taken in Unst (Shetland), 1895. *The Entomologist's Monthly Magazine* 32, 151-152.

Macan, T.T. (1973). *A Key to the Adults of the British Trichoptera*. Freshwater Biological Association Scientific Publication No. 28.

McLachlan, R. (1884a). Trichoptera from Unst, North Shetland. *The Entomologist's Monthly Magazine* 21, 91.

McLachlan, R. (1884b). Notes on a small collection of Trichoptera from Unst, North Shetland. *The Entomologist's Monthly Magazine* 21, 153-155.

Otto, C. (1981). Why does duration of flight periods differ in caddis flies? *Oikos* 37, 383-386.

Owen, J.A. (1989). An emergence trap for insects breeding in dead wood. *British Journal of Entomology and Natural History* 2, 65-67.

Townsend, C.R. and Hildrew, A.G. (1978). Predation strategy and resource utilisation by *Plectrocnemia conspersa* (CURTIS) (Trichoptera: Polycentropodidae). In *Proceedings of the 3rd International Symposium on Trichoptera* (Moretti, G.P. ed.) Junk, The Hague., pp. 283-291.

Wallace, I.D., Wallace, B. and Philipson, G.N. (1990). *(A key to the Case-Bearing Caddis Larvae of Britain and Ireland)*. Freshwater Biological Association Scientific Publication No. 51.